REMARKS

Claims 1-3 and 5-11 are pending in the present Application. Claim 1 is independent. Claim 4 has been canceled. Claim 1 has been amended to incorporate the subject matter of claim 4.

Claim Rejection – 35 U.S.C. 103; Zimmermann, Nayar and Juday

Claims 1-4 and 7-11 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Zimmermann (U.S. Patent 5,185,667), Nayar (U.S. Patent 5,760,826), and Juday et al. (U.S. Patent 5,067,019, hereinafter "Juday"). Applicants respectfully traverse this rejection.

Claim 1 (as amended to incorporate claim 4)

Summary of the Claimed Subject Matter

The present claimed invention, in a preferred embodiment, is directed to an omniazimuthal visual system (e.g., Fig. 1: omniazimuthal visual system 100), comprising:

an optical system capable of instantaneously obtaining an image of 360° view field area therearound and capable of central projection transformation for acquiring the image (e.g., Fig. 1: optical system 101; Hyperboloidal mirror optical system of Fig. 2);

an imaging section for converting the image obtained through the optical system into image data represented by polar coordinates (e.g., Fig. 1: imaging section 102);

an image transformation section for transforming the image data into display data represented by rectangular coordinates (e.g., Fig. 1: image transformation section 104);

a display section for displaying a transformed image based on the display data from the image transformation section (e.g., Fig. 1: display section 105); and

a display control section for controlling the transformed image to be displayed on the display section (e.g., Fig. 1: display control section 106),

wherein the image transformation section (e.g., Fig. 3) includes

at least one buffer memory for temporarily storing the image data and the display data (e.g., input buffer memory 108),

an arithmetic/logic circuit for performing coordinate transformation of a polar coordinate when the image data is transformed into the display data as a rectangular coordinate (e.g., arithmetic/logic circuit 111) with reference to a lookup table of a trigonometric function (e.g., lookup table of a trigonometric function 110), and

a CPU (e.g., CPU 109) for controlling the at least one buffer memory, the arithmetic/logic circuit, and the lookup table;

and wherein the arithmetic/logic circuit is formed only by linear operation circuits (paragraph bridging pages 19 and 20, which states that,

"Due to such an optical system, when a lookup table (LUT) 110 is used, the image transformation section 104 (Figure 1) can carry

> out an image transformation, i.e., the image transformation section 104 can transform image data into display data, such as a panoramic image, a perspective image, etc., only with linear operations and without nonlinear operations"; examples of the arithmetic/logic circuit are shown in Figures 6, 7, and 8).

The present invention is a very high speed, and of simple circuitry, visual system capable of 360° view field area for use in, for example, a surveillance camera.

Summary of the Office Action

The final Office Action of July 14, 2004 (hereinafter "Office Action") states that Juday's address lookup table 34 and factor lookup table 36 teaches the claimed lookup table of a trigonometric function (Office Action at page 4, first full paragraph). The Office Action further states that Juday's multiplier (30, 68) and adder (42, 72) teach the claimed arithmetic/logic circuit. Applicants note that it appears that Juday's address and factor memory 56 are also implicitly argued in the Office Action.

With respect to claim 4, the Office Action states that Juday clearly teaches the arithmetic/logic circuit being formed only by linear operation circuit (referring specifically to col. 9, lines 18-34, in particular equation 3).

Juday

Equation 3 of Juday is the equation performed by the interpolative processor (see column 9, lines 22-24, which states that, "Weights for each such pixel are stored in memory in look-up tables 56 and the [interpolative] processor performs the equation"). The interpolative processor is used where the coordinates of the mapping grid are more densely packed than the actual pixels of the image sensor. Under such condition, it is necessary to interpolate among existing input pixels to determine the radiance value of an output pixel. (column 8, lines 19-25). An interpolation of radiance values is performed for interpolation input pixels to determine the radiance to be assigned to the selected output pixel. Figure 7 shows a preferred interpolation method. (column 8, lines 31-37).

Juday is directed to a programmable remapper which acts on image data from a conventional video camera, or alternatively an array of charge coupled devices (column 5, lines 3-9). The resulting image data produced from the camera is a matrix of pixel cell coordinates and radiance values of pixels of an x-y Cartesian matrix according to a matrix of I columns and J rows (column 5, lines 12-16). The address in the matrix is designated by its position in the matrix (i, j). The programmable remapper transforms the input pixels and their pixel values into an output Cartesian matrix (u, v) characterized by K columns and L rows. An output image of the remapped image may be displayed on a monitor (column 5, lines 16-30).

Thus, it can be seen that Juday is limited to a field of view of a conventional video camera and performs transformation of an input Cartesian matrix (i, j) into another Cartesian matrix (u, v). Thus, Juday does not disclose an arithmetic/logic circuit for performing coordinate transformation of a polar coordinate when the image data is transformed into the display data as a rectangular coordinate.

Furthermore, none of the lookup tables of Juday are of a trigonometric function. With respect to the disclosed Collective Processor 20, Juday explicitly states that, "the function of the Address Look-up table 34 is to identify the output position k,l of the output matrix of u columns and v rows (column 6, lines 66-68). Juday explicitly states that, "the factor look-up table, with address i,j of the present pixel I(i, j), includes a ore-computed and stored weighting factor w(i, j) which is applied to multiplier 30 (column 7, lines 1-9; see also lines 61-63). Similarly, with respect to the disclosed Interpolative Processor 22, Juday states that,

> "FIG. 4 illustrates the interpolative processor where pixel values are periodically applied to buffer memory 50 where all the input image pixel values are stored in an input Cartesian coordinate system. Sequencer 52 steps through memory 56 in a predetermined manner. Because the entire output image is not created with the interpolative processor, not every output pixel k,l is selected, but rather, the particular output pixels k,l are selected according to the requirements of a particular stored transform. Sequencer 52 applies such output matrix coordinates to address and factor memory 56 via

> flow lead 54. For each output pixel location k,l, address and factor memory 56 contains the address of the leading corner input pixel at i.sub.o, j.sub.o of the input pixel matrix, and also includes weighting factors w(i.sub.o,j.sub.o) to w(i.sub.o+3,j.sub.o+3) of the four by four array or patch of pixels about the input pixel for which interpolation is necessary." (column 8, lines 52-68).

Thus, in each case the lookup tables of Juday are for storing addresses and associated weighting factors. In the case of the Interpolative Processor, the memory 56 contains the address of the leading corner input pixel of the input pixel matrix, and includes weighting factors of the four by four array of pixels about the input pixel. The lookup tables do not contain trigonometric function values as alluded to in the Office Action.

Furthermore, because Juday only discloses a remapper for transforming from one Cartesian matrix to another Cartesian matrix, and thus does not teach an arithmetic/logic circuit for performing coordinate transformation of a polar coordinate when the image data is transformed into the display data as a rectangular coordinate with reference to a lookup table of a trigonometric function, Juday does not teach or suggest wherein the arithmetic/logic circuit is formed only by linear operation circuits.

Zimmermann

Zimmermann is directed to an omnidirectional image viewing system having a fish-eye lens for omnidirectional image viewing within a hemispherical field of view. The device includes an image processing system for mathematically transforming the circular image obtained to a proper perspective image at real time rates. The mathematical transformation requires non-linear functions, for example, equations 17 and 18 for mapping between UV object space and XY image space. (column 7, lines 24-54).

Nayar

Nayar discloses an omnidirectional imaging device for simultaneously sensing an image of two complementary hemispherical scenes from a single viewpoint (see column 9, lines 33-44). The mathematical transformation used requires non-linear functions (see Appendix 1).

Differences over Juday, Zimmermann, and Nayar

As mentioned above, Juday fails to teach or suggest at least the claimed "arithmetic/logic circuit for performing coordinate transformation of a polar coordinate when the image data is transformed into the display data as a rectangular coordinate with reference to a lookup table of a trigonometric function", "wherein the arithmetic/logic circuit is formed only by linear operation

circuits." Both Zimmermann and Nayar disclose mathematical transformations that require non-linear functions. Thus, Zimmermann and Nayar fail to make up for the deficiencies of Juday. Also, as has been stated several times before, none of Juday, Zimmermann and Nayar disclose a lookup table of a trigonometric function. Accordingly, Applicants submit that the rejection fails to establish *prima facie* obviousness and request that the rejection be withdrawn.

No evidence has been provided to show motivation to combine Juday, Zimmermann, and Nayar to obtain the claimed invention

Juday provides no teaching whatsoever of a capability to scale up to transformation of omnidirectional image viewing including a circuit for performing coordinate transformation of a polar coordinate into display data as a rectangular coordinate with only linear operation circuits. Both Zimmermann and Nayar teach transformations requiring non-linear operations. Thus, Applicants submit that no evidence has been provided to show motivation to combine Juday, Zimmermann and Nayar to obtain the claimed invention.

Claims 10, 11

Further with respect to claims 10 and 11, Applicants submit that neither Zimmermann nor Juday teach circuits that perform alternative functions and that

only require changing one or two, respectively, parameters to perform each of the alternative functions.

Thus, for at least these additional reasons, the rejection fails to establish *prima facie* obviousness for claims 10 and 11.

Accordingly, Applicants respectfully request that the rejection be withdrawn.

Claim Rejection – 35 U.S.C. 103; Zimmermann, Juday, Nobutoshi

Claims 5 and 6 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Zimmermann, Nayar, and Juday as applied to claim 1 above, and further in view of Nobutoshi (JP 06-295333).

Nobutoshi would not motivate one of ordinary skill to use only linear functions in Zimmermann.

Nobutoshi does appear to teach an optical system having a hyperboloid mirror, but does not teach an image transformation section that uses only linear functions and that can be implemented using a look-up table for a trigonometric function. Also, Nobutoshi does not teach the claimed "rotation axis" since its mirrors are not rotatable. Thus, Nobutoshi fails to make up for the deficiency of Zimmermann of using only linear functions, and in particular, capable of being implemented using a look-up table. Thus, Applicants submit that the rejection fails to establish *prima facie* obviousness.

CONCLUSION

In view of the above remarks, reconsideration of the rejections and allowance of each of claims 1-3, 5-11 in connection with the above-identified application is earnestly solicited.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Robert W. Downs (Reg. No. 48,222) at the telephone number of the undersigned below, to ***arrange for an interview*** in an effort to expedite prosecution in connection with the present application.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,

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